DEVELOPMENT OF EXPLANATORY AND PREDICTIVE MODELS FOR HUNTING AND FISHING LICENSE SALES IN NEW YORK AND TREND ANALYSIS OF HUNTING LICENSE SALES FOR FIVE WILDLIFE MANAGEMENT UNITS

by

Nancy A. Connelly and Tommy L. Brown

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Human Dimensions Research Unit
Department of Natural Resources
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
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PROGRESS REPORT

STATE: NEW YORK

PROJECT NO.: W-146-R:14

PROJECT TITLE: Public Attitudes Toward Wildlife and Its Accessibility

STUDY NUMBER AND TITLE: I - Deriving Social Indices of Public Attitudes Toward Wildlife Populations and Their Use

JOB NUMBER AND TITLE: I-11 - Monitoring Trends in Human Population Characteristics of Importance to Wildlife Program Planning

JOB OBJECTIVES: To analyze the relationships between New York State population and user demographic trends and license sales performance.

To assist in wildlife program evaluation and planning by predicting trends in resource use and revenue levels associated with such use.

JOB DURATION: 1 July 1986 - 30 June 1989

AND

JOB NUMBER AND TITLE: I-12 - Determination of the Nature and Demographics of Wildlife Recreation Demand, by Ecozone-based Wildlife Management Units

JOB OBJECTIVES: To analyze the potential to stratify demand by ecozone and SMSA using secondary (existing) data sources.

To derive estimates of the relative size (i.e., extent and intensity) of wildlife demand based on assessments of secondary data.

To identify the need to collect primary data to estimate demand, and determine the feasibility of acquisition.

JOB DURATION: 1 July 1986 - 30 June 1989

EXECUTIVE SUMMARY

This report combines the work of 2 closely related Jobs: Job I-11 and Job I-12. In the first section of this progress report socio-demographic and resource based models are used to explain and predict hunting and fishing license sales statewide (Job I-11). These models have been reported on in their various stages of development in 3 previous progress reports. This report updates the models using data on statewide license sales from 1962 to 1988. All 3 models (big game hunting , small game hunting, and fishing) predict declining license sales into the 1990's. This is due to a combination of demographic factors and probable fee increases. License fee increases can be thought of as causing a short-term decline in sales. Most often in the past the decline caused by a fee increase is negated within a few years. However, trends in demographic factors such as population and employment used in the models provide an indication of longer term license sale trends. These variables are expected to increase in magnitude in the next 5 years. Since they have negative coefficients in the models, their influence results in a small but long-term decline in predicted license sales.

The second part of the report examines trends in hunting license sales for 5 Wildlife Management Units (Job I-12). These units are currently in the WPMS planning process. Thus, estimates of hunting demand are of interest to DEC. The current demand for hunting can be estimated from data presented on license sales in the Unit plus calculating the proportion of demand from surrounding urbanized areas. The summary section of the report examines how future demand in these Units can be projected based on variables used in the statewide models, thus setting the stage for the combination of Job I-11 and I-12 in the next AFA.

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INTRODUCTION

This report combines the work of 2 closely related Jobs: Job I-11 and Job I-12. Because of their close ties these 2 jobs will in fact be combined in the next AFA. In the first section of this progress report socio-demographic and resource based models are used to explain and predict hunting and fishing license sales statewide (Job I-11). In Part II, trends in hunting license sales for 5 Wildlife Management Units (WMUs) are examined. The current demand for hunting in these WMUs can be estimated from data presented on license sales in the WMU and in surrounding urbanized areas (Job I-12). The summary section provides a discussion of how the statewide models can be used in conjunction with the WMU license sale trend analysis to estimate future demand for hunting in the WMUs.

PART I: STATE-LEVEL LICENSE SALE MODELS

This is the fourth in a series of reports that have dealt with factors affecting hunting and fishing licenses sales in New York, and the revenue implications of those changing factors. This report utilizes data from the state longitudinal data base for the years 1962-1988. Models from this data base have been reported before in 1985, 1986, and 1988 progress reports (Brown 1985, Brown and Connelly 1986, Brown and Connelly 1988). These models investigate 3 types of resident licenses--small game hunting, big game hunting, and fishing. Each model is structured to include all licensees who could have participated in that activity. The following license types comprise these resident license groupings:

1. Small Game. Small game + small game/big game + small game/fishing + sportsman's licenses.
2. Big Game. Big game + small game/big game + sportsman's licenses.

3. Fishing. Fishing + 3-day fishing + small game/fishing + sportsman's licenses.

When combined as indicated above, these 3 types of licenses are referred to as adjusted small game, big game, and fishing licenses.

This report presents 3 updated (including data through 1988) state-level longitudinal models for adjusted small game, big game, and fishing license sales. Demographic data had to be estimated for 1988 and in some cases for 1987. The regression models were constructed using the minitab statistical package (Ryan, Jr. et al. 1982).

Small Game License Sales

Adjusted small game license sales appear to have leveled off in the last 3 or 4 years after dropping by about 12% from 1982-1986 (Fig. 1). This may indicate a stabilization of small game licence sales which have experienced a significant overall decline in the last 15 years. However another decline would be expected when license fees increase.

Two small game models were developed and presented in the last progress report because no one model was able to encompass all relevant factors (due to high correlations between independent variables). After adding data for the years 1987 and 1988, these same 2 models continue to provide the best explanatory power for variation in license sales. They are presented here with their updated coefficients.

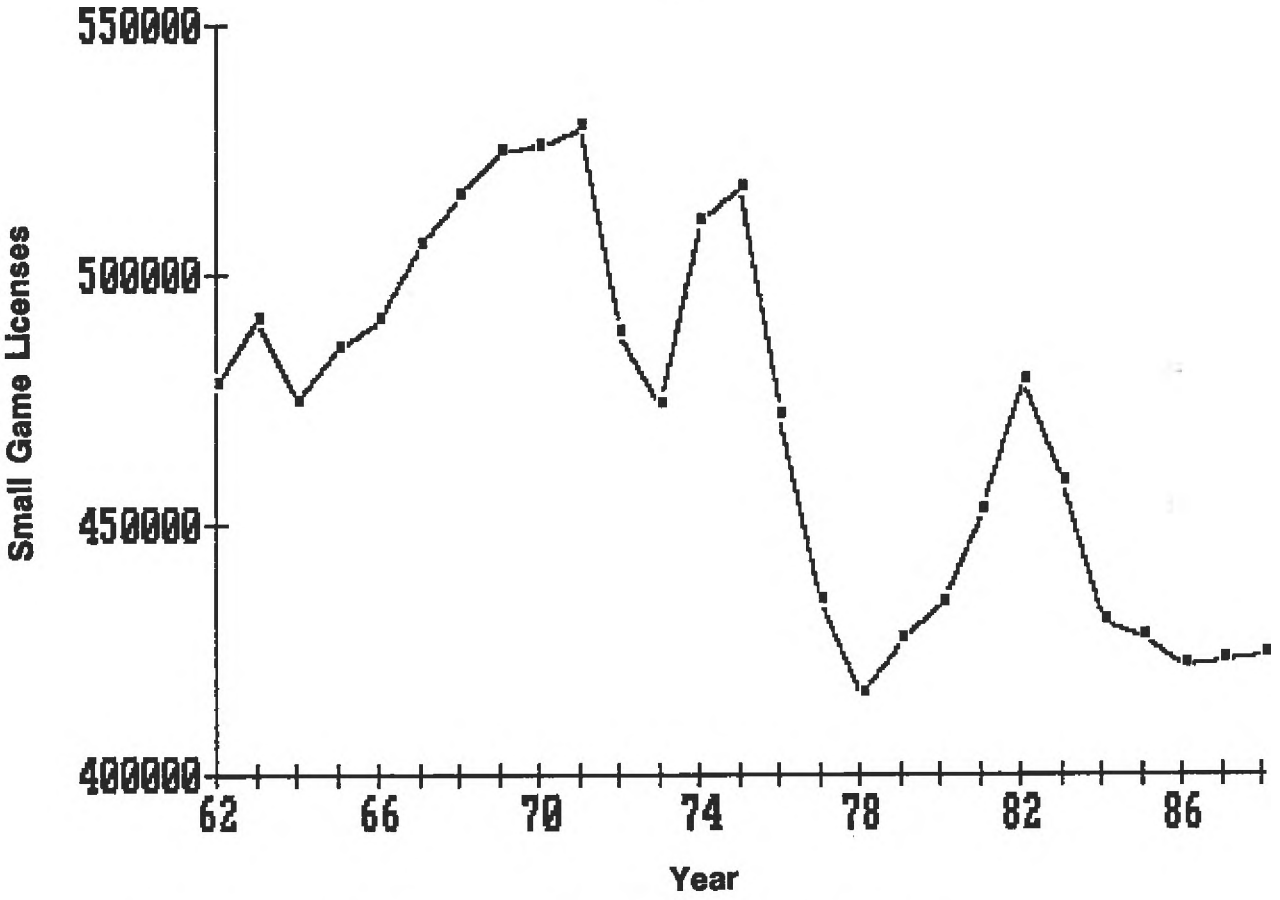

Figure 1. Adjusted small game license sales, 1962-1988.

The best explanatory model including population size for small game license sales (with standard deviations in parentheses) was:

$$SGLS = \underset{(14,658)}{444,116} - \underset{(24.89)}{53.75}\,(P14\text{-}64 - Mean) - \underset{(0.057)}{0.089}\,(P14\text{-}64 - Mean)^2 + \underset{(951.8)}{3790.4}\,PI$$

where:

SGLS = Adjusted resident small game license sales;

(P14-64 - Mean) = NY 14-64 age population minus mean of NY 14-64 age population (thousands);

$(P14\text{-}64 - Mean)^2$ = (NY 14-64 age population minus mean of NY 14-64 age population)^2 (thousands);

PI = Index of the pheasant population in central and western NY (the "pheasant/observer index").

This model has an adjusted r^2 of .747 and a standard deviation of 18,782 licenses.

The second small game license sale model describes the effect of license cost on sales. The best explanatory model including license cost for small game license sales (with standard deviations in parentheses) was:

$$SGLS = \underset{(23,358)}{477,827} - \underset{(2,950)}{7,631}\ \$\$ + \underset{(150.5)}{285.5}\ LCyc^2 + \underset{(1,030)}{2,658}\ PI$$

where:

SGLS = Adjusted resident small game license sales;

$$ = Weighted license fee;

$LCyc^2$ = (License cycle which rises each year by 1 until a fee increase, which resets it to 0)^2;

PI = Index of the pheasant population in central and western NY (the "Pheasant/observer index").

This model has an adjusted r^2 of .786 and a standard error of 17,262 licenses.

Both models show an improvement in r^2 and a reduction in the standard error over models reported in the last progress report. (See that report [Brown and Connelly 1988] for a detailed discussion of the independent variables.)

Since the pheasant index is expected to remain constant over the next 10 years and the 14-64 aged population will continue a very gradual increase into 1995 (<1%), the first model, which has no license fee variable, predicts a constant level of small game license sales. However fee increases seem likely, therefore projections from the second model would suggest declining small game license sales with a decrease of 7,631 licenses for each dollar of a fee increase. The license cycle variable would predict a continuing

cyclical pattern over time with a rise in license sales after the year of a fee increase. For example, if a fee increase of 2 dollars were implemented in 1989 and another 2 dollars in 1993 then the model predicts that fishing license sales would be expected to decline by 5% in 1990 and 8% in 1995 from current model estimates.

Big Game License Sales

Unlike small game license sales which seem to be leveling off after several years of decline, big game license sales are continuing a slow rate of decline after peaking in 1982 (Fig. 2).

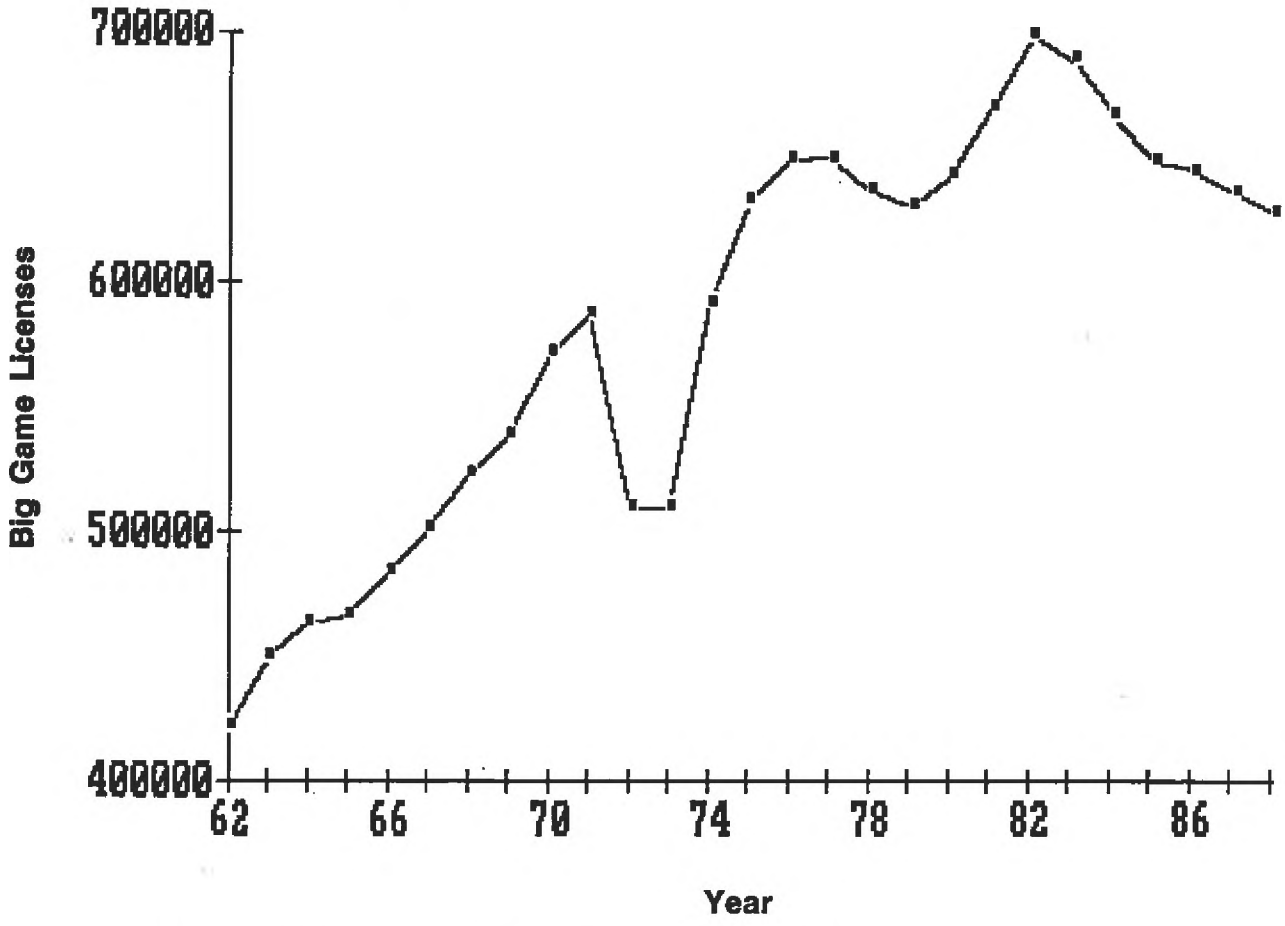

Figure 2. Adjusted big game license sales, 1962-1988.

The model reported previously continued to be the best explanatory model. For the license sale years 1962-1988, the best explanatory model for adjusted big game license sales (with standard deviations in parentheses) was:

$$BGLS = \underset{(199,149)}{665,596} + \underset{(43.71)}{88.47}\ REAL - \underset{(50.45)}{146.91}\ NAg + \underset{(87.94)}{259.33}\ IM$$

$$- \underset{(5,055)}{17,267}\$\$ + \underset{(0.47)}{1.58}BH^{-1} + \underset{(0.18)}{0.47}\ LS^{-1} - \underset{(14,231)}{20,600}\ INC$$

where:

BGLS = Adjusted resident big game license sales;

REAL = NY per capita income, adjusted for inflation;

NAg = Total nonagricultural employment in New York (thousands);

IM = Miles of interstate highway open in New York;

$$ = Weighted license fee;

BH^{-1} = Adult bucks harvested the previous year;

LS^{-1} = Big game license sales the previous year;

INC = Dummy variable indicating the year of a license fee increase.

This model has an adjusted r^2 of .949 and a standard deviation of 18,654 licenses. The independent variables had similar coefficients to the model reported previously, but the coefficient for the license fee variable has increased somewhat. For each dollar increase the model predicts that the number of licenses sold would decrease by a little over 17,000.

Projections of big game license sales into the 1990's depends on our ability to predict future trends for the several independent variables. Based on the projections shown in Table 1, the model suggests a long-term decline in license sales for 1990, reaching a decline of about 20% by 1995. The 2 variables having the greatest effect on the downward projections are

nonagricultural employment, which we believe is an index of increased urbanization, and necessary license fee increases. The urbanization factor has a far greater influence on the downward projection than license fee increases (by a factor of approximately 7 in the 1995 projection).

Table 1. Projections for variables in the big game license sale model and the resultant predicted license sales.

Variables	Current		Projected	
	1987	1988	1990	1995
REAL	5,289	5,390	5,500	5,700
NAg	8,053	8,200	8,450	8,650
IM	1,505	1,510	1,515	1,520
$$	8.19	8.18	10.20	13.20
BH^{-1}	90,719	97,595	100,000	100,000
LS^{-1}	644,168	635,774	625,000	625,000
INC	0	0	0	0
Predicted License Sales	645,418	641,145	579,304	517,112

Fishing License Sales

Sales have increased over the last few years and have shown a fairly consistent cyclical pattern over the past 25 years related to license fee increases (Fig. 3).

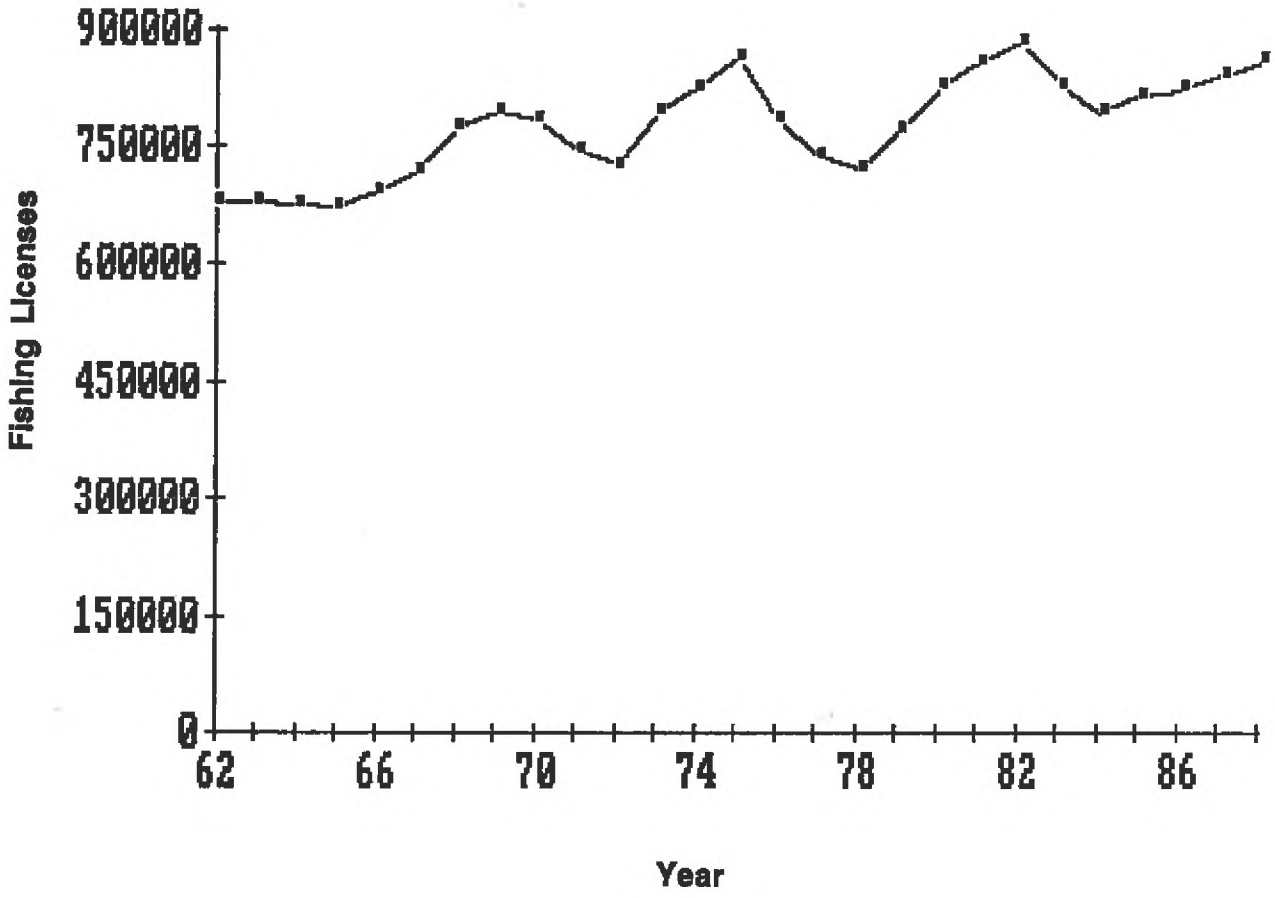

Figure 3. Adjusted fishing license sales, 1962-1988.

The best long-term explanatory model (with standard deviations in parentheses) was:

$$\underset{}{FLS} = \underset{(141,565)}{223,304} + \underset{(21.63)}{73.76}\ P18\text{-}44 + \underset{(2,209)}{8,569}\ LCyc + \underset{(19,168)}{94,260}\ USAL + \underset{(23,608)}{41,020}\ STGL$$

where:

FLS = Adjusted resident fishing license sales;

P18-44 = NY 18-44 age population (thousands);

LCyc = License cycle variable which rises each year by 1 until a fee increase, which resets it to 0;

USAL = Dummy variable representing the years 1973-75 when the Great Lakes salmonid fisheries opened, and before the discovery of contaminants;

STGL = Dummy variable representing the years 1980-88 of full stocking of salmonids in the Great Lakes.

This model has an adjusted r^2 of .799 and a standard deviation of 28,614 licenses. This is the same model reported in the previous progress report, but with updated coefficients. Since the major influencing factor for long term projections is the 18-44 age population segment, which is expected to decline through 1995, the model would predict a slight general decline (3 to 4%) in sales by 1995, independent of license fee increases. The cyclical pattern would be expected to continue due to anticipated fee increases.

PART II: WMU LICENSE SALE TRENDS

Data on trends in small game and big game hunting license sales will be examined for the 5 WMUs currently in the WPMS planning process. These trends in license sales along with information on license sales in surrounding urbanized areas can be used as indicators of hunting demand. Prediction of future trends for these 5 units will be examined in the summary section in light of demographic variables in the state-level models.

Calculating Hunting License Sales by WMU

Since WMU's follow ecological boundaries rather than political boundaries, it was necessary to apportion license sales from the county-level data base to each WMU. License sale records are maintained by DEC by county of purchase rather than county of residence. It was necessary to use county of purchase data as a proxy for county of residence although we know they are not always the same. To apportion county license sales to WMU's, the data base

containing 1980 population by WMU was used (Connelly and Brown 1987). For rural counties (those not containing an urbanized area), the number of males aged 14-64 residing in each county was used to derive percentages of the 5 WMU's in each county. For counties containing an urbanized area, total population was used to calculate the percentage of the 5 WMU's and urbanized areas in each county. These percentages were then applied to the county-level license sale data base (1962-1988) to estimate the license sales in the 5 WMU's and the state's urbanized areas.

Appalachian Plateau WMU

The Appalachian Plateau covers most of the southern portion of central and western New York. It is the largest WMU geographically and surrounds the urbanized areas of Elmira and Binghamton. The trend in small game license sales for the WMU has been relatively constant over the 27 year period (Fig. 4). Big game license sales have shown more of an increasing trend. The big game trend is very similar to the statewide trend, while small game license sales do not show the decrease of the statewide trend.

To estimate current demand for hunting on the Appalachian Plateau, 1988 license sales were used for that unit and surrounding urbanized areas. Table 2 shows 1988 license sales and the change in sales from 1962 to 1988. To estimate total demand for hunting in the Appalachian Plateau, managers will have to estimate the extent of demand from surrounding urbanized areas and add that to the total for the WMU and the enclosed urbanized areas.

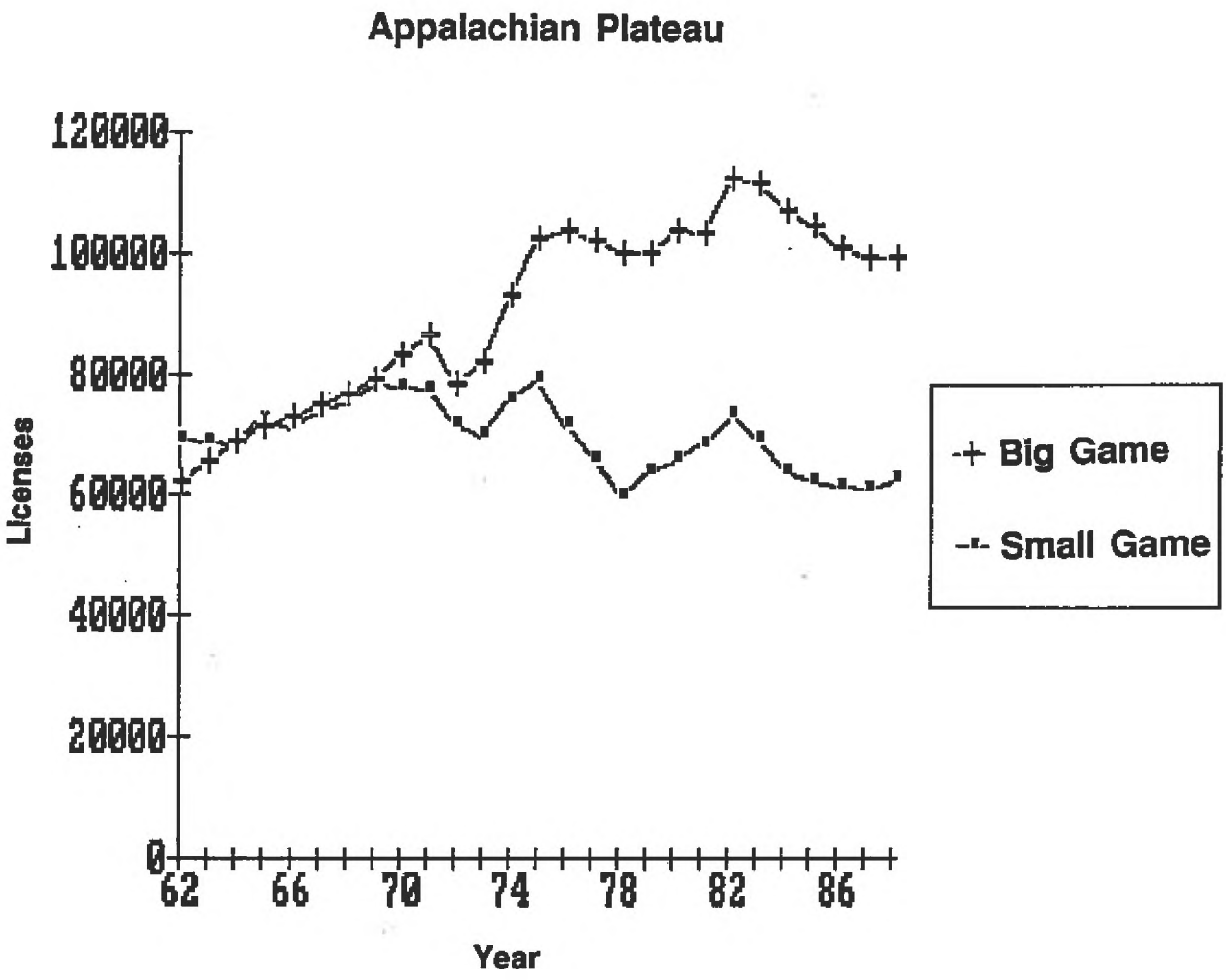

Figure 4. Small game and big game license sales in the Appalachian Plateau Management Unit, 1962-1988.

Table 2. Sources of demand for the Appalachian Plateau Management Unit.

	1988 Big Game License Sales	% change in Big Game License Sales (1962-1988)	1988 Small Game License Sales	% change in Small Game License Sales (1962-1988)
Areas				
Appalachian Plateau	98,976	+59.3	62,458	-9.6
Elmira	5,737	+32.9	3,753	-26.9
Binghamton	14,177	+24.9	8,628	-29.0
TOTAL	118,890		74,839	
Surrounding Urban Areas				
Buffalo	47,304	+58.2	33,288	-21.9
Rochester	24,352	+82.6	18,890	-16.3
Syracuse	19,648	+65.8	12,882	-22.2
Utica-Rome	11,017	+38.0	6,592	-27.9

St. Lawrence Valley WMU

The St. Lawrence Valley management unit is located in the northeastern part of New York State and is not adjacent to any urbanized area. Undoubtedly there is some demand from other areas of the state but no one area can account for a large influx of demand. The trend in license sales is shown in Figure 5. The St. Lawrence Valley is very different from the rest of the state in small game license sales. The number of licenses sold has risen 17.7% since 1962 to a total of 8,027 in 1988. Big game license sales have followed the statewide trend more closely and increased by 31.5% since 1962 to 11,384 licenses sold in 1988.

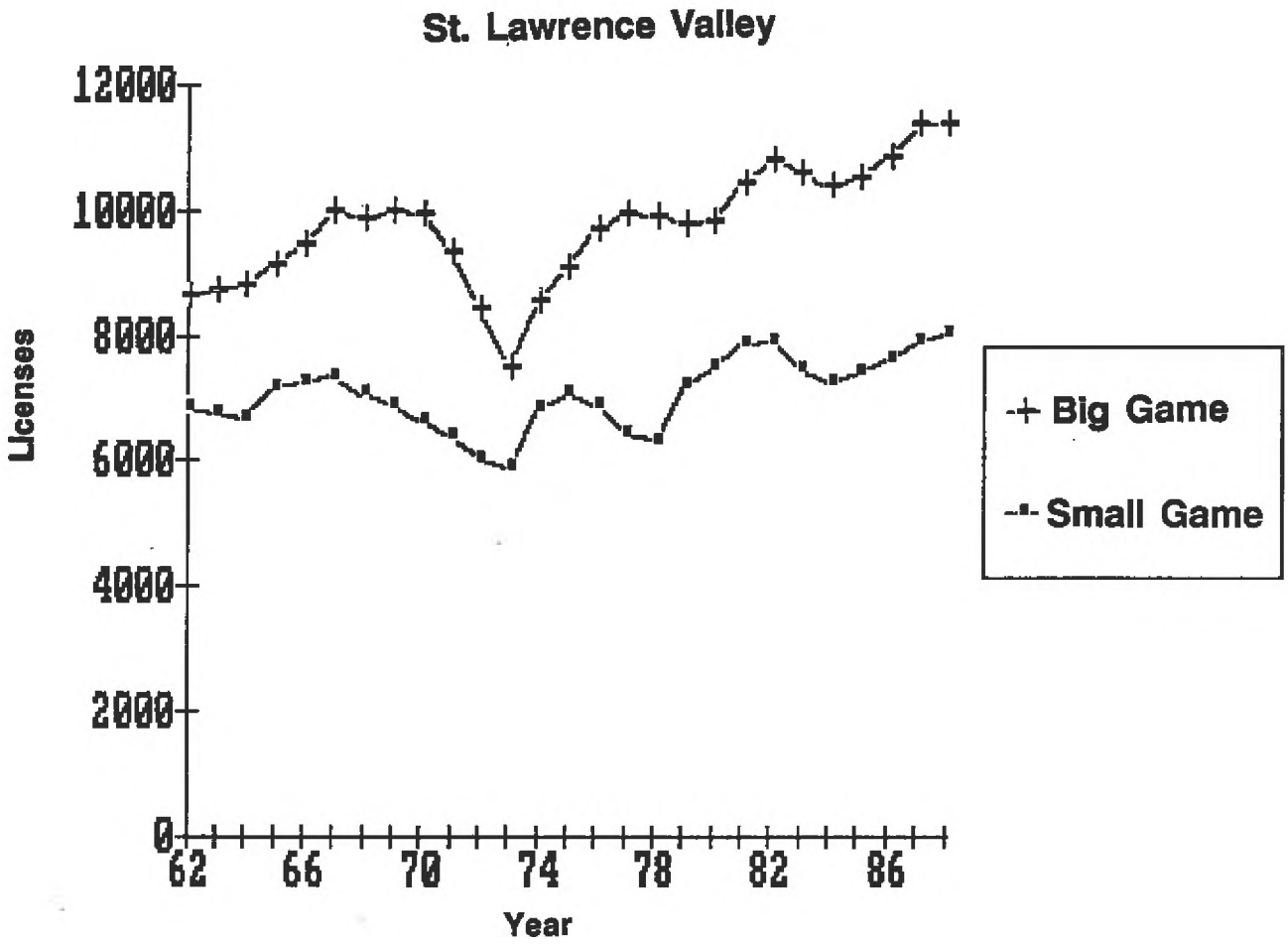

Figure 5. Small game and big game license sales in the St. Lawrence Valley Management Unit, 1962-1988.

Central Adirondacks WMU

The Central Adirondacks management unit in the heart of the Adirondack mountains has several surrounding urban areas which contribute to the demand for hunting in the WMU. The trend in license sales within the unit has remained extremely constant over the past 27 years (Fig. 6). Small game license sales have declined by only 3% compared to the statewide decline of 11%; big game license sales have increases by only 12%, compared to the statewide increase of 49%.

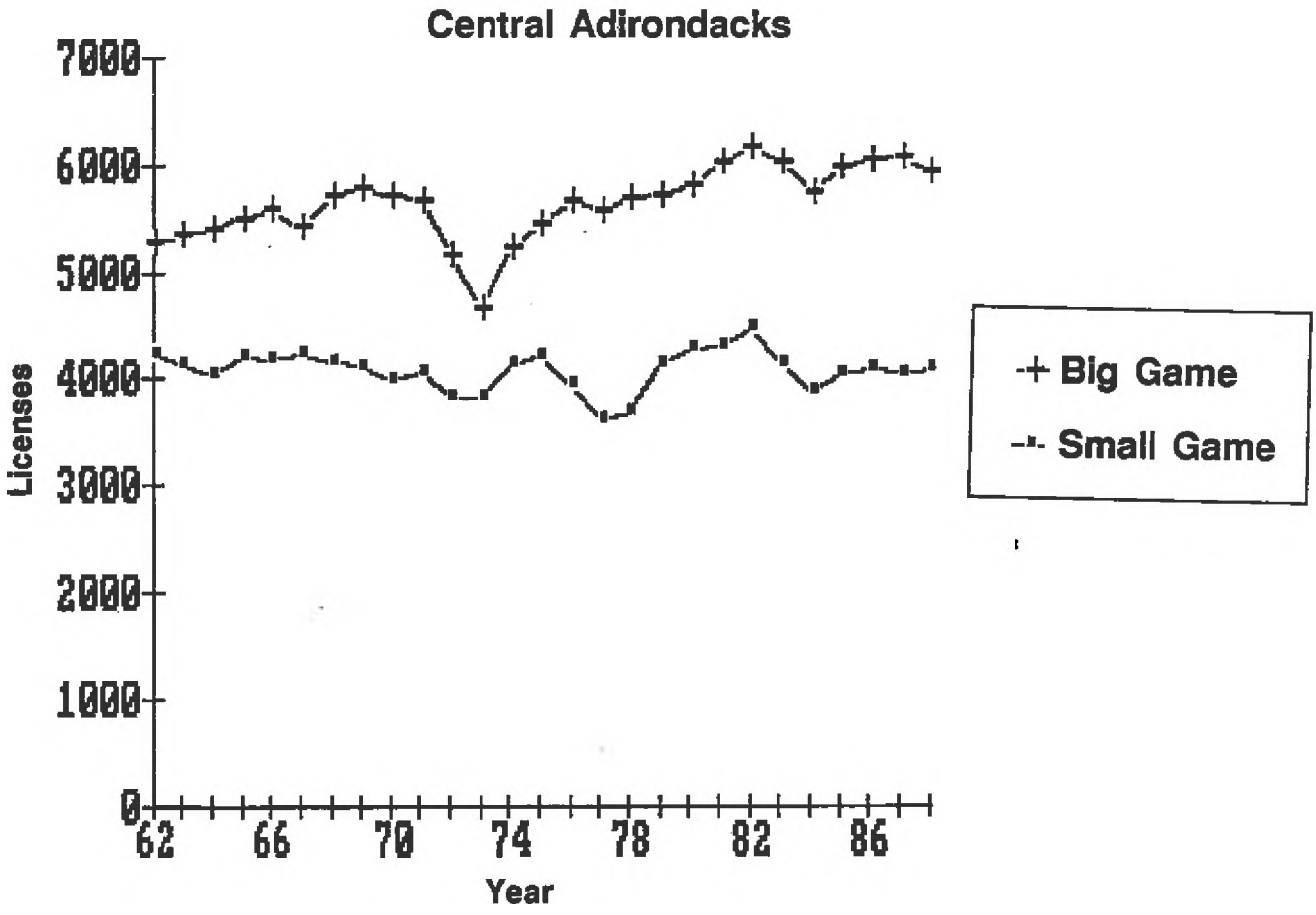

Figure 6. Small game and big game license sales in the Central Adirondacks Management Unit, 1962-1988.

The demand for hunting from surrounding urban areas can be estimated from the figures in Table 3. Much of the demand for hunting in this unit may well come from the surrounding urban areas.

Table 3. Sources of demand for the Central Adirondacks Management Unit.

	1988 Big Game License Sales	% change in Big Game License Sales (1962-1988)	1988 Small Game License Sales	% change in Small Game License Sales (1962-1988)
Areas				
Central Adirondacks	5,915	+11.9	4,091	-3.3
Surrounding Urban Areas				
Utica-Rome	11,017	+38.0	6,592	-27.9
Glens Falls	5,357	+46.5	3,631	-4.8
Albany-Schenectady-Troy	25,462	+43.7	17,422	-20.7

Hudson Valley WMU

The Hudson Valley WMU begins just south of Albany and extends south down the Hudson River Valley to just north of New York City. It surrounds the urbanized areas of Poughkeepsie and Newburgh. The trend in small game licenses sales in the Hudson Valley has declined only slightly in the past 27 years (Fig. 7). Big game license sales have generally followed the statewide trend, increasing by 39% since 1962. Within the Hudson Valley management unit are 2 urban areas where big game license sales have been increasing faster than the statewide average (Table 4). These areas plus the management unit and a portion of the demand from surrounding urban areas comprise the vast majority of total resident hunting demand in the Hudson Valley.

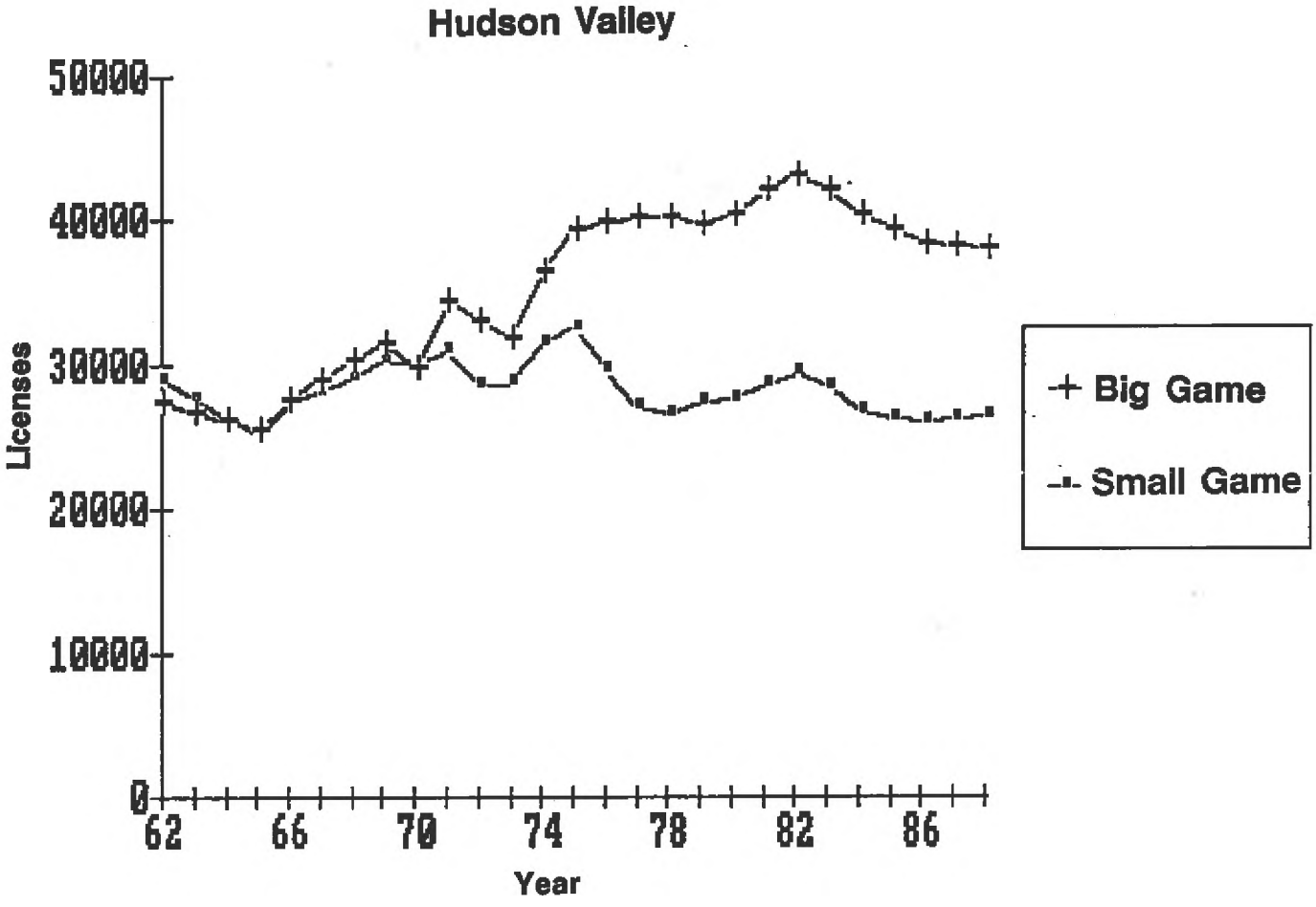

Figure 7. Small game and big game license sales in the Hudson Valley Management Unit, 1962-1988.

Table 4. Sources of demand for the Hudson Valley Management Unit.

	1988 Big Game License Sales	% change in Big Game License Sales (1962-1988)	1988 Small Game License Sales	% change in Small Game License Sales (1962-1988)
Areas				
Hudson Valley	38,008	+38.6	26,357	-8.7
Poughkeepsie	7,582	+59.3	5,083	-7.7
Newburgh	3,962	+57.8	2,894	-5.3
TOTAL	49,552		34,334	
Surrounding Urban Areas				
Albany-Schenectady-Troy	25,462	+43.7	17,422	-20.7
New York City	100,336	+23.9	68,250	-15.3

Coastal Lowlands WMU

The Coastal Lowlands WMU comprises the eastern most portion of Long Island. The demand for hunting in this area is limited almost exclusively to people living in the management unit and some demand from the New York City urban area. The demand for hunting in this area has been generally increasing over time (Fig. 8). The sudden jump in both big game and small game sales in 1988 is probably due to increased sales of licenses that allow big game hunting. Sales of all license types permitting big game hunting increased, while those only allowing small game hunting remained the same or declined. Very few licenses are sold in the Coastal Lowlands (Table 5). Those licenses plus some portion of demand from New York City make up the total demand for the Coastal Lowlands management unit.

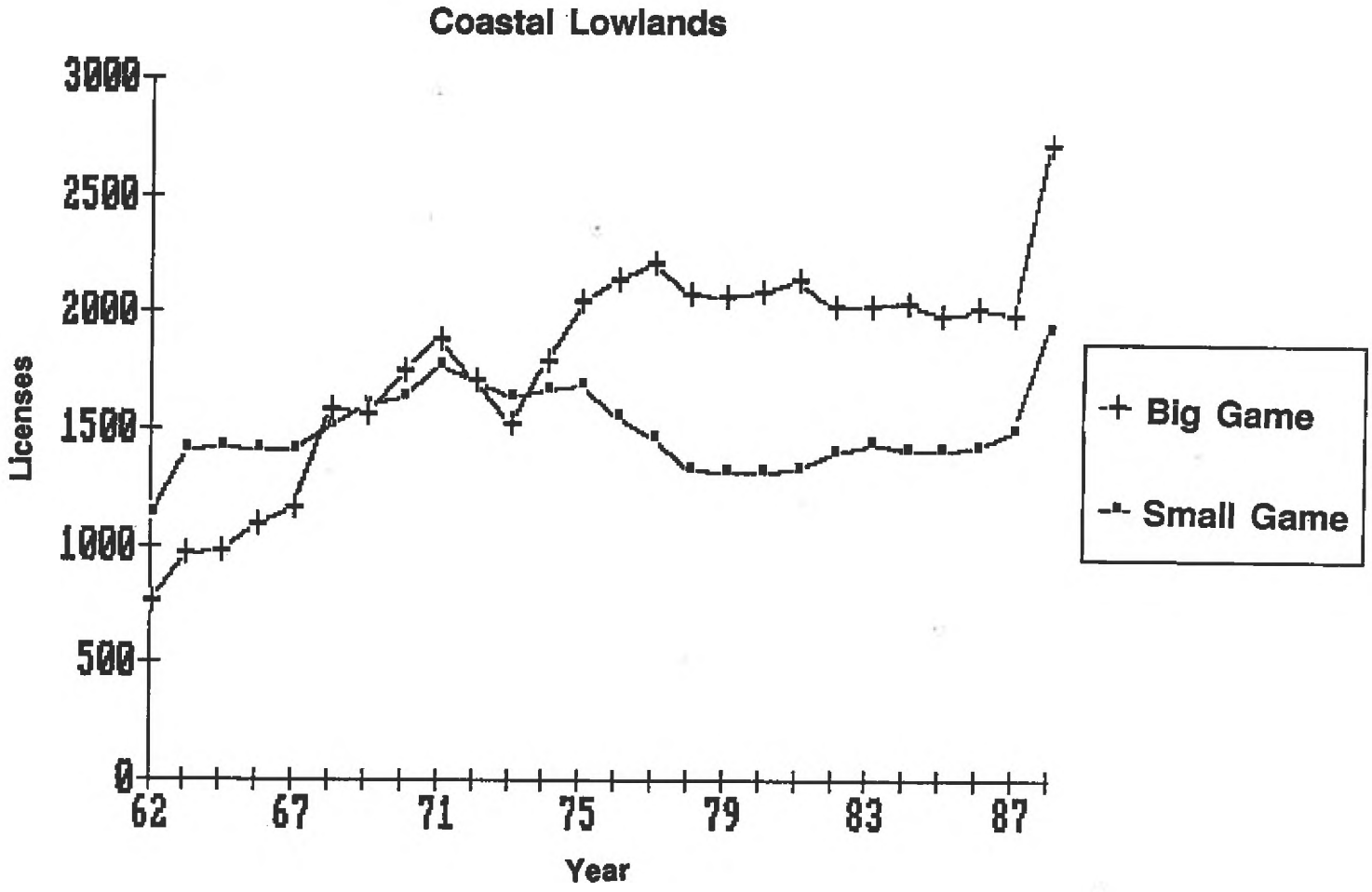

Figure 8. Small game and big game license sales in the Coastal Lowlands Management Unit, 1962-1988.

Table 5. Sources of demand for the Coastal Lowlands Management Unit.

	1988 Big Game License Sales	% change in Big Game License Sales (1962-1988)	1988 Small Game License Sales	% change in Small Game License Sales (1962-1988)
Areas				
Coastal Lowlands	2,717	+260.3	1,923	+70.3
Surrounding Urban Areas				
New York City	100,336	+23.9	68,250	-15.3

SUMMARY

The statewide big game and small game hunting models both predict declining license sales into the 1990's. This is due to a combination of demographic factors and probable license fee increases. License fee increases can be thought of as causing a short-term decline in sales. Most often in the past the decline caused by a fee increase is negated within a few years. However, trends in demographic factors such as the number of people aged 14-64 or nonagricultural employment can give an indication of longer term license sale trends. Both of these factors, important to the small game and big game models respectively, are expected to increase in the next 5 years and thus by their negative coefficients produce a predicted decline in license sales.

The WMUs by their design are generally rural, providing various types of habitats for wildlife. The trends in license sales in the WMUs do not seem to reflect the statewide trend, especially in small game license sales. The WMUs tend to have had a stable level of small game license sales while the surrounding urban areas showed a significant decline in sales. As the state-level population figures indicate, New York's population has passed from the

point where more people mean more licenses sold to where more people (ie., more urbanization) mean fewer licenses sold. Therefore, the extent to which a WMU has higher participation from outside urban areas should be closely related to how much hunting demand will continue to decline in the foreseeable future.

Using license sales to estimate WMU hunting demand is an imperfect measure. The exact contribution of surrounding urban areas to a WMU's hunting demand is unknown. Only a manager's best estimates can be used at this point. We continue to recommend modification of current DEC data collection efforts, as outlined in a previous progress report for Job I-12 (Connelly et al. 1988), which would provide data on sources of hunting demand (i.e., WMU, surrounding urbanized areas) for each WMU.

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